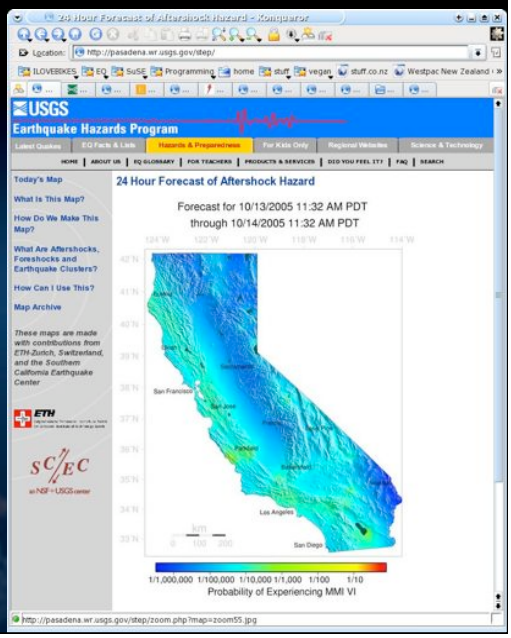
Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

USGS Online Short-term Hazard Maps

Experiences in the First Year of Implementation

Matt Gerstenberger
Lucy Jones

USGS



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Aftershock probabilities

- Probability determined from Omori's Law and Gutenberg-Richter relation
  - Reasenberg and Jones, 1989
- Rupture forecast, not shaking
- First issued as public statements in 1989

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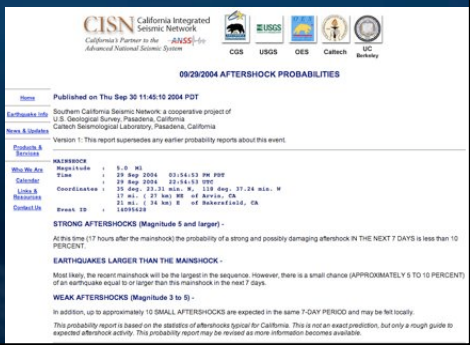
Problems with present system

- Predicting events without spatial information
- Time decay not communicated
  - Message on Internet often days out of date



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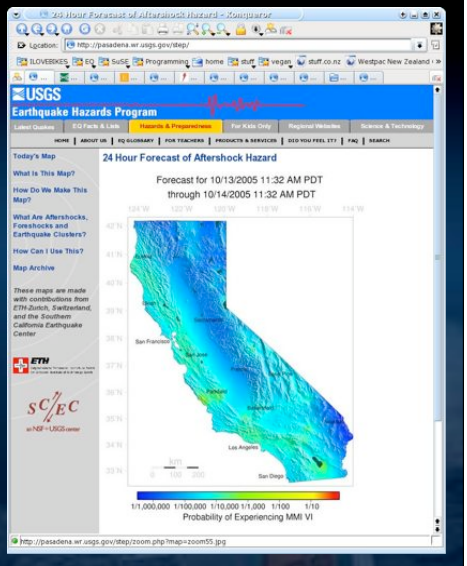
Short Term Earthquake Probabilities (STEP)

- 24 hour forecast
- probability of exceeding MMI VI
- automatic calculations
- online
- real-time
- updated every half-hour



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California Seismic Hazard Map

- Default (when no seismic activity)
- Helps communicate real risk
  - One email said "Stop scaring my mother"

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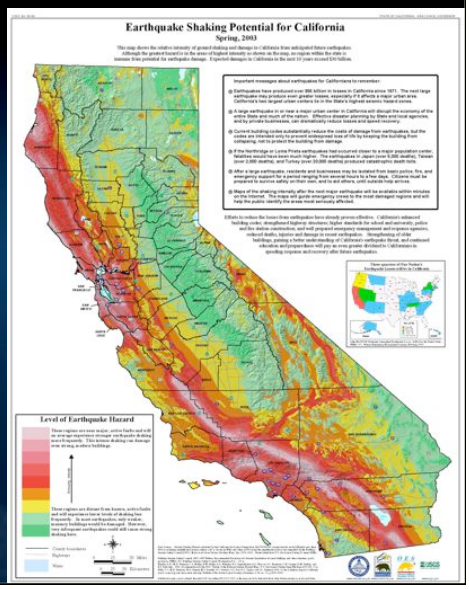

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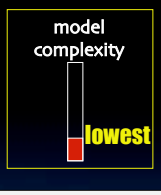
The Aftershock Models

Generic California Model



Generic parameters calculated using California aftershock sequences (1932-1987)

Only requires mainshock magnitude as input

Present policy

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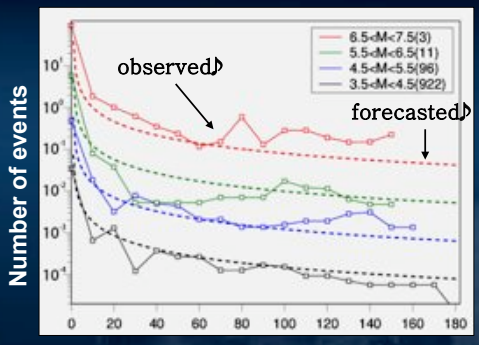

California aftershock rates (1988-2003) vs. Generic model

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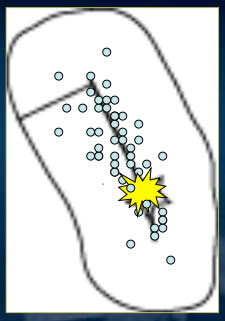
The Aftershock Models

Sequence Specific Model

model complexity: medium

needs minimum of 100 aftershocks before estimating parameters

One set of model parameters (Gutenberg-Richter and modified Omori laws) calculated for the entire aftershock sequence



The aftershock zone

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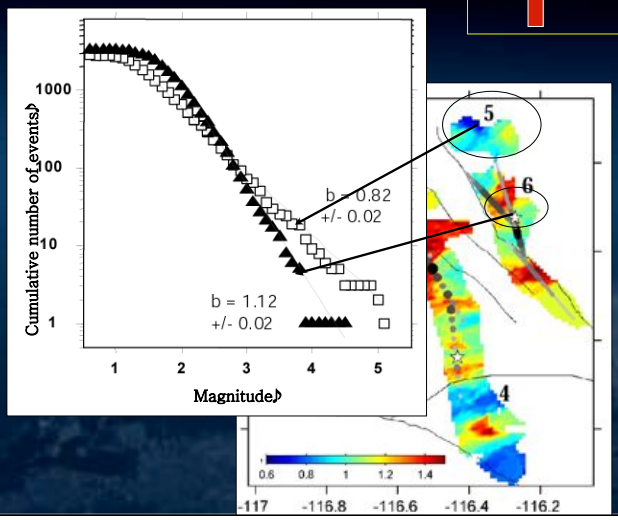
The Aftershock Models

Spatially Varying Model

model complexity: highest

Gutenberg-Richter and modified Omori law parameters are mapped at 5km spacing



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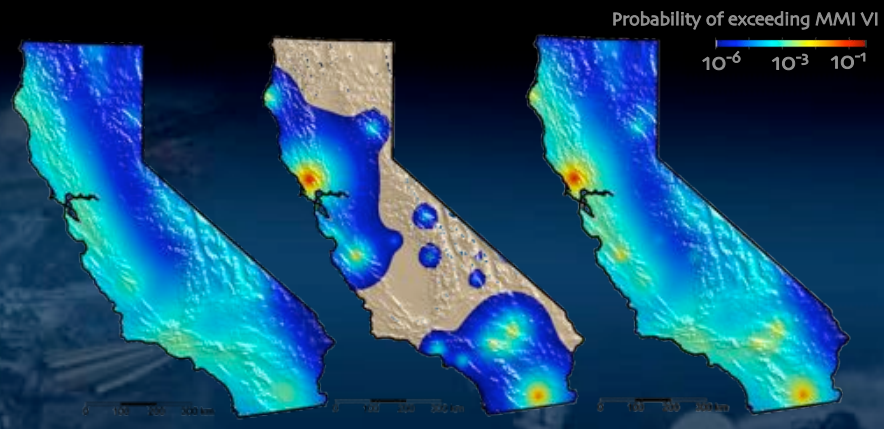
Time dependent California hazard map



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Testing our forecasts

Test ONE: When forecasts are made retrospectively, are they consistent with the observed earthquakes?

When: 1992-1996

Where: southern California

How: Likelihood test. How likely were the observed events and non-events based on our forecast?

What: Earthquake size(M4,M4.1,M4.2,…M8.0); location (5km squares); When (24 time periods).

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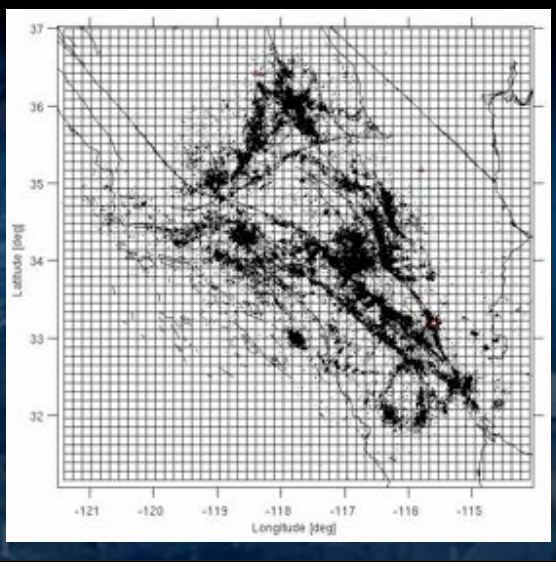
Our forecasts are consistent with actual earthquakes



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Comparison testing

Test TWO: When our model is compared to more simple models, does our more complex model give a better forecast?

When: 1992-1996
Where: southern California
How: Likelihood ***ratio*** test. How likely were the observed events and non-events in our forecast as compared to more simple models?
What: Earthquake size(M4,M4.1,M4.2,…M8.0); location (5km squares); When (24 time periods).

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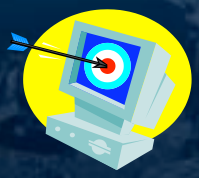
The less complex forecasts:

1. background forecast (no time dependent info)
2. #1 + generic California forecast
3. #2 + sequence specific forecast

The RESULT???

In all cases the forecast from our most complex model fits the data better than those of the less complex models



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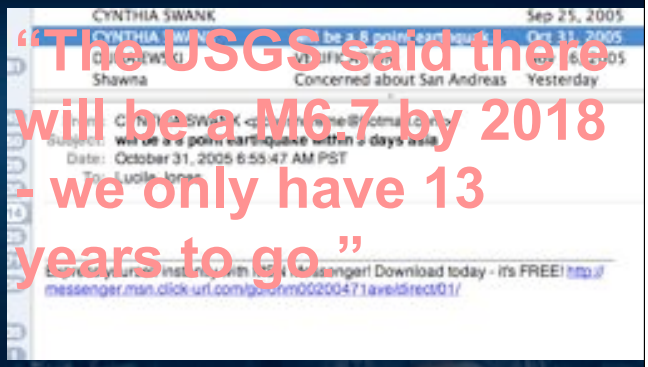
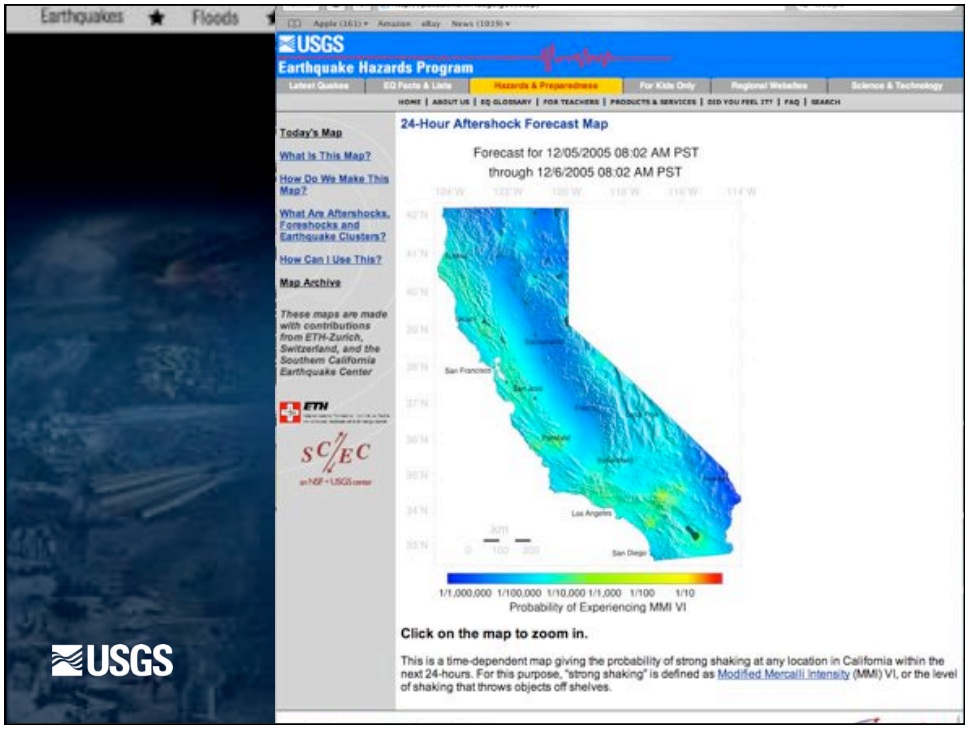
Public reaction

- **You can't please everyone**



"The USGS said there will be a M6.7 by 2018 - we only have 13 years to go."

USGS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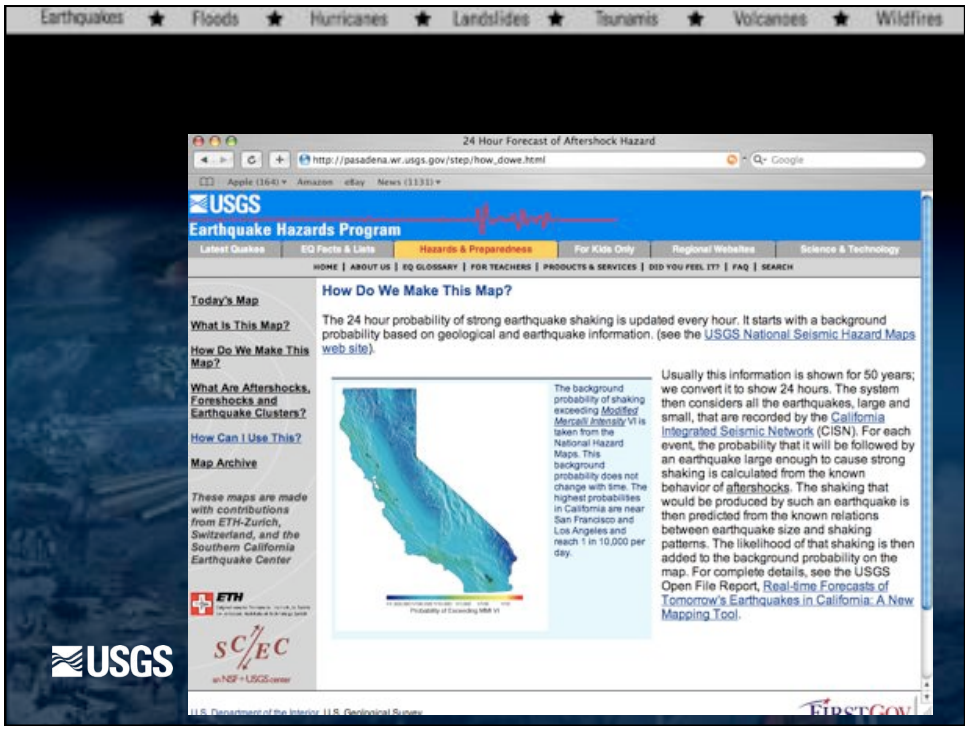
Earthquake Hazards Program
Latest Quakes | EQ Facts & Lists | Hazards & Preparedness | For Kids Only | Regional Websites | Science & Technology
HOME | ABOUT US | EQ GLOSSARY | FOR TEACHERS | PRODUCTS & SERVICES | DID YOU FEEL IT? | FAQ | SEARCH
Today's Map
What Is This Map?
How Do We Make This Map?
What Are Aftershocks, Foreshocks and Earthquake Clusters?
How Can I Use This?
Map Archive
These maps are made with contributions from ETH-Zurich, Switzerland, and the Southern California Earthquake Center
ETH
SCEC
an NSF+USGS center
24-Hour Aftershock Forecast Map
Forecast for 12/05/2005 08:02 AM PST
through 12/6/2005 08:02 AM PST
San Francisco
Los Angeles
San Diego
1/1,000,000 1/100,000 1/10,000 1/1,000 1/100 1/10
Probability of Experiencing MMI VI
Click on the map to zoom in.
This is a time-dependent map giving the probability of strong shaking at any location in California within the next 24-hours. For this purpose, "strong shaking" is defined as Modified Mercalli Intensity (MMI) VI, or the level of shaking that throws objects off shelves.
USGS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24 Hour Forecast of Aftershock Hazard
http://pasadena.wr.usgs.gov/step/how_dowe.html
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How Can I Use This?
Map Archive
These maps are made with contributions from ETH-Zurich, Switzerland, and the Southern California Earthquake Center
ETH
SCEC
an NSF+USGS center
How Do We Make This Map?
The 24 hour probability of strong earthquake shaking is updated every hour. It starts with a background probability based on geological and earthquake information. (see the USGS National Seismic Hazard Maps web site).
The background probability of shaking exceeding Modified Mercalli Intensity VI is taken from the National Hazard Maps. This background probability does not change with time. The highest probabilities in California are near San Francisco and Los Angeles and reach 1 in 10,000 per day.
Usually this information is shown for 50 years; we convert it to show 24 hours. The system then considers all the earthquakes, large and small, that are recorded by the California Integrated Seismic Network (CISN). For each event, the probability that it will be followed by an earthquake large enough to cause strong shaking is calculated from the known behavior of aftershocks. The shaking that would be produced by such an earthquake is then predicted from the known relations between earthquake size and shaking patterns. The likelihood of that shaking is then added to the background probability on the map. For complete details, see the USGS Open File Report, Real-time Forecasts of Tomorrow's Earthquakes in California: A New Mapping Tool.
U.S. Department of the Interior, U.S. Geological Survey
FirstGov
USGS

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Three M~5 events since May

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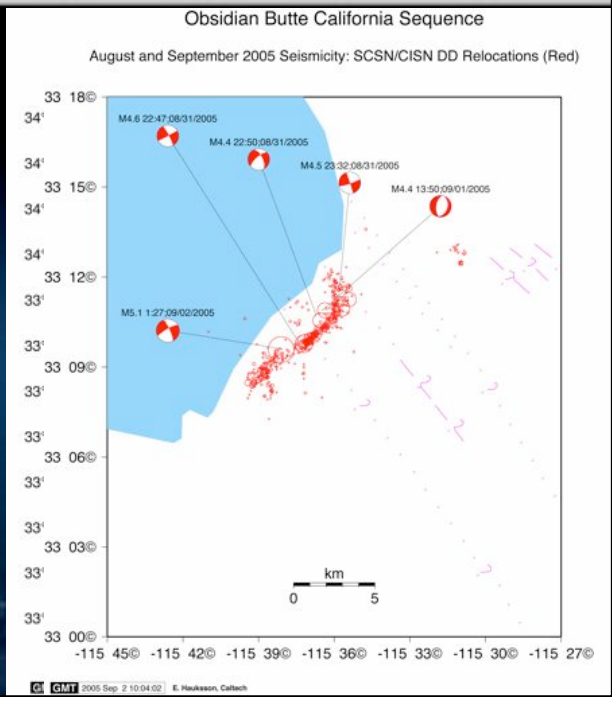

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STEP for the M5 events

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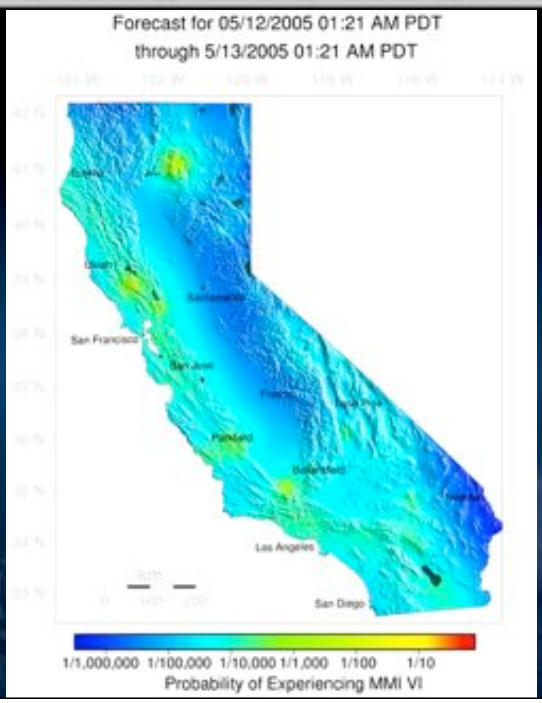

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Most common emails

- Add my town name
- Extend it to another region of the country
- Make it easier to find
- Requests for supporting curriculum
- What is intensity?
- Everyone knows we have aftershocks so what's the big deal?
  - We changed the name to "aftershock probability"
- Stop scaring my mother

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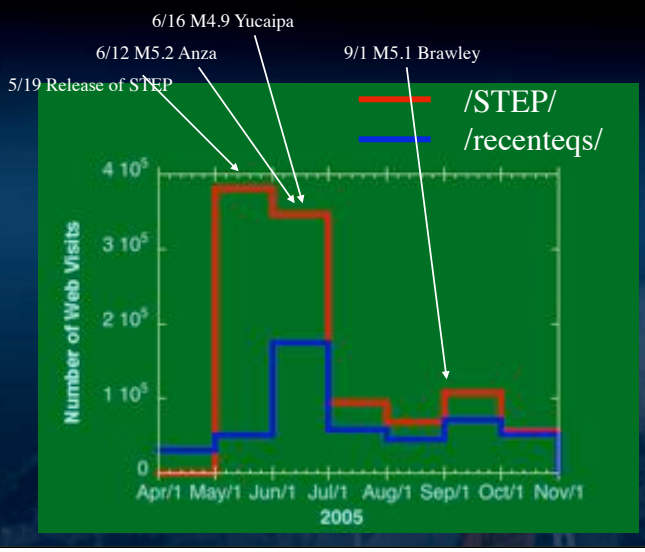
Visits to STEP web pages



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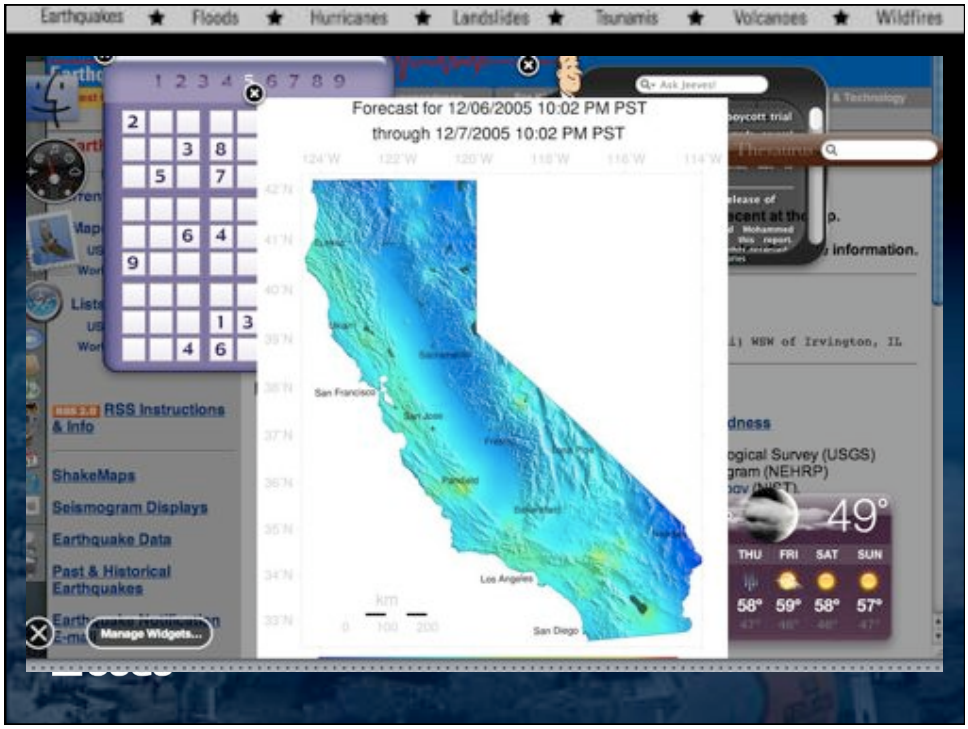
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Wildfires
Forecast for 12/06/2005 10:02 PM PST
through 12/7/2005 10:02 PM PST
RSS Instructions & Info
ShakeMaps
Seismogram Displays
Earthquake Data
Past & Historical Earthquakes
Manage Widgets...
San Francisco
Los Angeles
San Diego
49°
THU FRI SAT SUN
58° 59° 58° 57°